

A neotype for *Trochammina inflata* (Montagu) (Protozoa: Foraminiferida) with notes on the wall structure

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Introduction

Montagu (1808: 81, pl. 18, fig. 3) introduced under the name *Nautilus inflatus* . . . 'A non-descript species, rarely found amongst sand on the coast of Devon' and characterised it as follows:

Shell spiral, opaque, brown, with three lobated volutions; in the final whorl are five extremely ventricose articulations, anterior end subglobose: syphon placed as in *Nautilus Beccarii*. It is not so much depressed as that shell, nor are the articulations half so numerous, but vastly more timid; the size inferior.

This description is accompanied by a stylised hand-coloured drawing of the spiral side of a low trochospire with 5 well-separated subglobular chambers of a brown colour, each gradually increasing in size. Montagu's type specimen is lost and his illustration and very general description were of little help for the identification of *N. inflatus* until Williamson revised it in 1858. In his classic work *On the Recent foraminifera of Great Britain*, containing numerous accurate detailed observations, Williamson placed *N. inflatus* in *Rotalina* d'Orbigny and described the species in much more detail. A new and taxonomically important aspect of the revision concerns the apertural features. The position of the aperture is said to be 'septal', placed 'close to the preceding volution' (that is interiomarginal) and 'a little below its peripheral margin'. The umbilical and spiral sides, chamber form and intercameral sutures are all described and the wall texture is given as 'finely arenaceous'. In contrast to Montagu, Williamson called *Rotalina inflata* (Montagu) a 'very distinct species', but still added that it was rare.

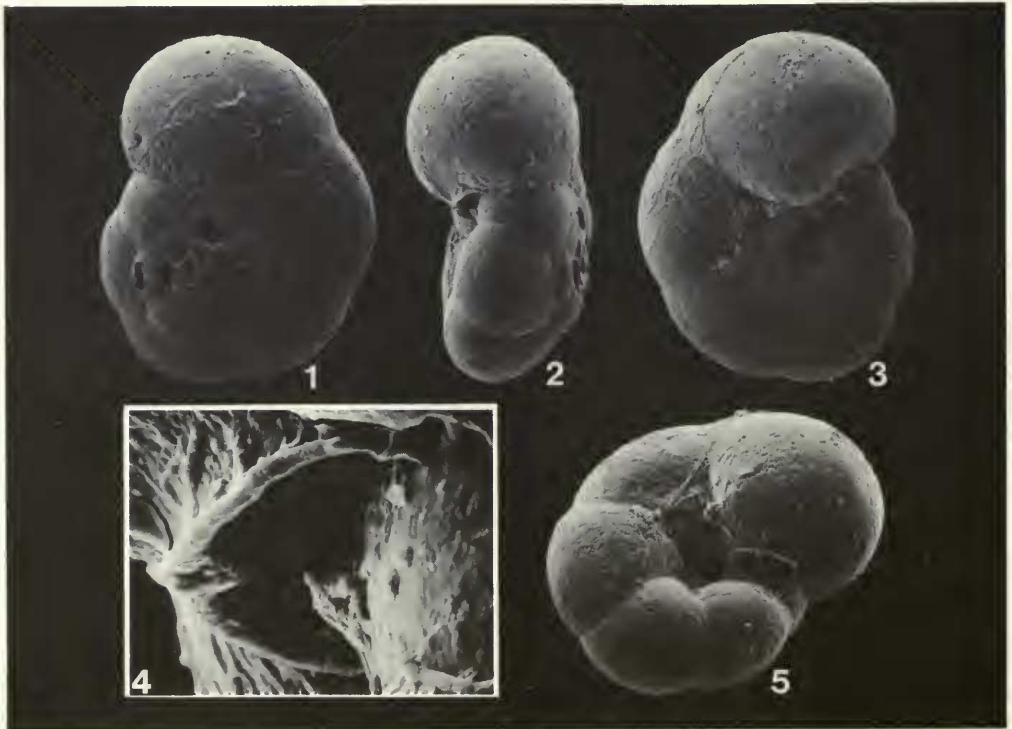
Apart from the coast of Devon, Williamson cited as localities: Weymouth, Swansea, Sandwich (J. G. Jeffrey, collector); Skye, Arran and Shetland (G. Barlee, collector). Williamson's revision (1858: 50, pl. 4, figs 93, 94) not only furnished the first adequate description, but also the first good illustrations of Montagu's species: they show the spiral side of a 6-chambered individual (final whorl) with the characteristic dark brown initial coil followed by two more coils, lighter brown in colour, consisting of subglobular chambers separated by incurved radial sutures (fig. 93); and the umbilical side of a 5-chambered individual with its small, deep axial depression and the straight intercameral sutures (fig. 94). These two specimens are missing from the extant part of the Williamson Collection in the British Museum (Natural History) but his revision proved adequate to define the species so that subsequent workers, at least in European waters, had few difficulties in identifying it.

It was also Williamson's work which provided the basis for Parker & Jones' (1859: 347) taxonomic comments on *N. inflatus* and for their proposition to place it in a few subgenus of *Rotalia* which they named *Trochammina*, a term derived from the Greek *trochos* (wheel) and *amos* (sand). Their comments are as follows:

This is a *Rotalia* of a typical specific form (as already remarked by Williamson) and characteristic of a subgenus. This sandy-shelled *Rotalia*, exhibiting a structural condition rare, if not unique, among the genus, differs from its congeners so strikingly in this particular, and in its almost globigerine mode of growth, that we propose to refer it to a separate subgenus under the name *Trochammina*.

The etymology of the name *Trochammina* and Parker & Jones' subgeneric definition explain that the essential feature of the new subgenus by which it is distinguished from *Rotalia*, is the sandy nature of the test. This would be, then, one of the first uses of the wall texture for systematic purposes. As to the occurrence of *R. (T.) inflata*, Parker & Jones find . . . 'its fullest development in shallow water, where it is sometimes very abundant. For instance some of the clay of the Peterborough Fens yields it profusely.' This seems also to be the first remark on the ecology of the species which later was confirmed by Brady (1887: 892) in his 'Synopsis of the British Foraminifera' where he wrote that it is . . . 'Rarely met with except in brackish water'.

Carpenter (1862: 141, pl. 11, fig. 5) not only elevated *Trochammina* to the rank of genus but extended its concept to include as the 'lowest and simplest' form the undivided planispiral tube (*Trochammina* [= *Ammodiscus*] *incerta*), the irregularly enrolled tube (*Trochammina* [= *Glomospira*] *gordialis*, and as the 'highest' form, the multilocular test (*Trochammina inflata*) developed by the segmentation of the undivided tube. With this extreme emendation *Trochammina* lost the particular meaning given it by Parker & Jones who had originally introduced the subgenus for *Nautilus inflatus* only. Furthermore, Carpenter's drawing (pl. 11, fig. 5) does not correspond at all with Williamson's form and is probably not *inflata*. It was much later, in the *Challenger* Report (Brady, 1884: 336), that



Figs 1–5 *Trochammina inflata* (Montagu). Neotype, ZF 4267. Ex E. Milton Collection, slide 1966.1.6.24. From brackish water, near Broadsands, Torbay, Devon. Spiral, edge and umbilical views; detail of aperture (in edge view), and oblique-umbilical view. Figs 1–3, 5, $\times 100$; fig. 4, $\times 700$.

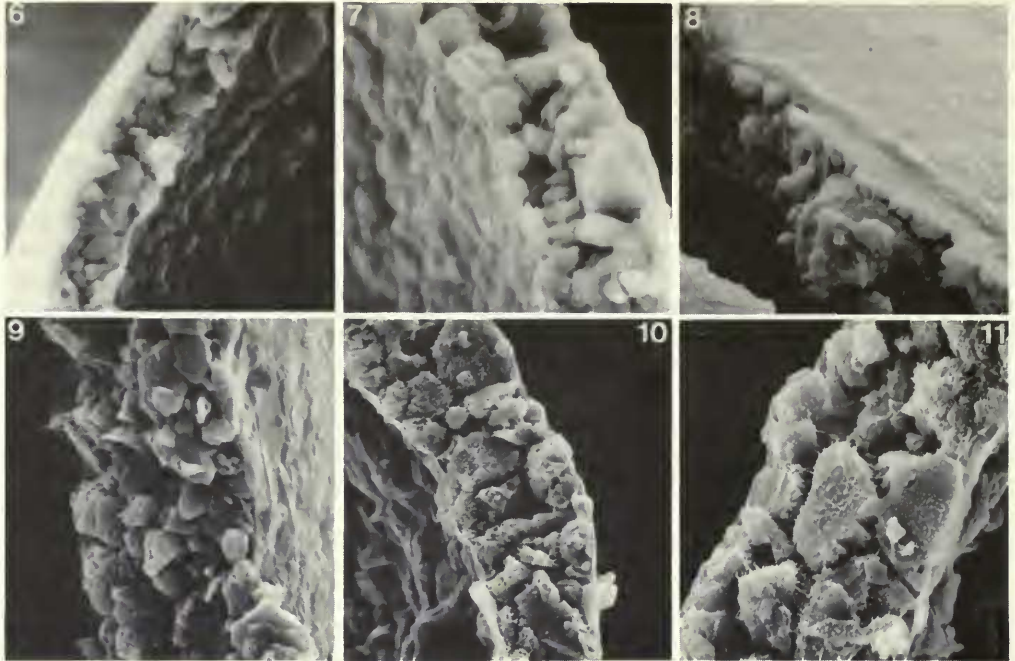
Trochammina was again restricted, this time to include all agglutinated, rotaliform or nautioid or irregularly coiled, chambered forms. Brady (1884, pl. 41, figs 4a–c) illustrated in three conventional views a typical *T. inflata*, which closely corresponds with the 5-chambered specimen of Williamson's pl. 4, fig. 94. Also Brady's description follows closely that of Williamson. The aperture is characterised as being small and arched, on the inferior side of the final chamber, close to the previous volution, a little within the periphery. The species, according to Brady, is found 'all round the British Islands. It frequents comparatively shallow water, and finds its way into estuaries and other brackish areas.' From this it appears that he thought it was a marine species which was able to survive in lower salinities. Today, we know that it is *restricted* to brackish waters in estuaries, salt marshes, lagoons and mangrove swamps worldwide, and from this environment it may be washed into adjacent marine sediments (Murray, 1971). Although no type of *T. inflatus* exists and Williamson's figured specimens are lost, the species is well defined taxonomically by the revisional work of Williamson (1858) and Brady (1884) and has for the most part been correctly identified in subsequent literature on European waters. Elsewhere, some references to *T. inflata* (e.g. Earland, 1934; Ingle *et al.*, 1980—from marine environments) are known to be incorrect. Nevertheless, it might still be argued that the establishment of a neotype was unnecessary, were it not for the fact that trochamminid classification is now actively under revision (see Brönnimann *et al.*, 1983), and *T. inflata* is particularly important as the type species of *Trochammina* Parker & Jones, which in turn, is type-genus of the subfamily Trochammininae Schwager. It was therefore decided to select a neotype from an assemblage of well preserved individuals in slide 1966.1.6.24 from the E. Milton Collection in the British Museum (Natural History). This material was collected in 1930 from a brackish pool at Broadsands, Torbay, Devon, SW England, and comes from the same county as Montagu's original specimen. The neotype of *T. inflata* has been re-registered as ZF 4267 and is illustrated by scanning electron microscopy in Figs 1–5. The opportunity is also taken to show the aperture and wall structure in detail, the latter, should this potentially important taxonomic criterion be used in future classification of the group (Figs 6–11).

The neotype of *Trochammina inflata* (Montagu)

DESCRIPTION. Test free, a sinistral trochospire; low-convex spirally, shallow-concave umbilically with a small but deep axial cavity. In spiral/umbilical view, outline of test broad-oval, slightly lobate; in edge view moderately compressed, with rounded peripheries. Chambers subglobular, 21 in number (including the proloculus), arranged in $3\frac{1}{2}$ whirls with 6 chambers in final whorl; increasing first slowly, then more rapidly in size. On umbilical side chambers of final whorl triangular and separated by roughly depressed, straight sutures; on spiral side, radial sutures incurved initially becoming straight in final part. Aperture single, interiomarginal, extraumbilical, an elongate open arch resting with its border on the first chamber of final whorl; this low arch extends from edge of axial depression to a subperipheral position, and has a border drawn out from the septal face in form of a collar limited by a thin upturned rim of smooth appearance. Each new chamber covers preceding aperture which therefore does not communicate with axial (umbilical) depression. Wall agglutinated with a finely granular surface texture, slightly more coarse on the umbilical than on spiral side; imperforate. Colour of test brownish, darker initially than in the later chambers.

DIMENSIONS. Maximum umbilical/spiral diameter 470 μm , axial height (thickness) about 250 μm , width of axial cavity 50 μm . Maximum diameter of proloculus 25 μm . Radial and tangential diameters of final chamber 200 and 290 μm , respectively; axial height (thickness) 235 μm . Length and height (centre) of aperture 100 and 25 μm , respectively; width of apertural collar 15–20 μm .

REMARKS. The neotype was probably dead at the time of collection and does not show the glossy lustre typical of the surface of living specimens of *T. inflata*. As shown in the SEM



Figs 6–11 *Trochammina inflata* (Montagu). Figs 6–8, ZF 4268, wall broken to show structure: an inner organic layer, a thick agglutinated layer of irregular fragments, and an outer organic veneer. Figs 9–11, ZF 4269. Fig. 9, broken wall showing outer veneer and agglutinated layer; fig. 10, broken wall showing all three 'layers'; fig. 11, broken wall showing in particular nature of agglutinant and cement. ZF 4268 from Broadsands, Torbay, Devon; ZF 4269 from West Williamson, Dyfed. Magnifications between 1500 and 2500.

photographs in Figs 6–11, fresher specimens from the neotype locality and from West Williamson, Dyfed, SW Wales, have an imperforate wall of apparently 3 'layers'. A thin organic inner lining (= 'tectin lining' of Haynes, 1981, pl. 7, fig. 8), a thick agglutinated layer of medium sized, poorly sorted foreign elements and a thin organic outer layer which covers the middle layer like a veneer. It seems probable that the test of the neotype remained after death for some time in the water and was abraded, thus losing the organic outer layer. The thin algal filaments or fungal threads which criss-cross the surface, particularly on the umbilical side are often seen in death assemblages.

Cushman & Brönnimann (1948: 41, pl. 7, figs 21, 22) described from the mangrove swamps of the west coast of Trinidad, West Indies, a new species which they named *Trochammina laevigata*. It has 5 to 6 chambers in the final whorl (the holotype, pl. 7, fig. 21, has 6 chambers) and by its overall morphology and apertural characteristics appears to be identical to *T. inflata* (Montagu). Although the holotype of *T. laevigata* is much larger than our neotype of *T. inflata*, there is no reason to separate the two. *T. laevigata* Cushman & Brönnimann was also illustrated by Todd & Brönnimann (1957, pl. 4, figs 17, 18) in their paper on the foraminifera from the tidal zone of the eastern Gulf of Paria, Trinidad. The specimen on pl. 4, fig. 17 differs from *T. inflata* by a more lobulate outline and a somewhat higher trochospire, however these differences fall within the variation we have seen in large populations of *T. inflata* from many parts of the world. The other specimen illustrated by Todd & Brönnimann (1957, pl. 4, fig. 18) and referred to *T. laevigata*, is characterised by a *Siphotrochammina*-aperture, and is not conspecific.

Acknowledgements

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